November 10, 2010

Mr. Ralph Butler, Director
Research Reactor Center
University of Missouri-Columbia
Research Park
Columbia, MO 65211

SUBJECT: UNIVERSITY OF MISSOURI-COLUMBIA – NRC ROUTINE INSPECTION REPORT NO. 50-186/2010-204

Dear Mr. Butler:

On November 1–4, 2010, the U. S. Nuclear Regulatory Commission (NRC, the Commission) completed an inspection at the University of Missouri-Columbia Research Reactor (Inspection Report No. 50-186/2010-204). The enclosed report documents the inspection results, which were discussed on November 4, 2010, with you, Mr. Les Foyto, Reactor Manager, and other members of your staff.

The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. The inspector reviewed selected procedures and records, observed various activities, and interviewed personnel. Based on the results of this inspection, no findings of significance were identified. No response to this letter is required.

In accordance with Title 10 of the *Code of Federal Regulations* Section 2.390, "Public inspections, exemptions, and requests for withholding," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (Agencywide Documents Access and Management System (ADAMS)). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Should you have any questions concerning this inspection, please contact Craig Bassett at 301-466-4495 or by electronic mail at Craig.Bassett@nrc.gov.

Sincerely,

/RA/

Johnny H. Eads, Jr., Chief
Research and Test Reactors Oversight Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-186
License No. R-103

Enclosure: NRC Inspection Report No. 50-186/2010-204
cc w/encl: Please see next page

cc:

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Columbia, MO 65211

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Test, Research, and Training
Reactor Newsletter
University of Florida
202 Nuclear Sciences Center
Gainesville, FL 32611

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University of Missouri-Columbia
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DATE	11/7/2010	11/9/2010	11/10/2010

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U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION

Docket No.	50-186
License No.	R-103
Report No.	50-186/2010-204
Licensee:	University of Missouri - Columbia
Facility:	University of Missouri Research Reactor
Location:	Research Park Columbia, Missouri
Dates:	November 1–4, 2010
Inspector:	Craig Bassett
Approved by:	Johnny H. Eads, Jr., Chief Research and Test Reactors Oversight Branch Division of Policy and Rulemaking Office of Nuclear Reactor Regulation

EXECUTIVE SUMMARY

University of Missouri-Columbia
University of Missouri Research Reactor
Report No. 50-186/2010-204

The primary focus of this routine, announced inspection was the onsite review of selected aspects of the University of Missouri-Columbia (the licensee's) 10 Megawatt (10MW) Class I research and test reactor safety program including: 1) organizational structure and staffing, 2) review and audit and design change functions, 3) reactor operations, 4) operator requalification, 5) maintenance and surveillance, 6) fuel handling, 7) experiments, 8) procedures, and 9) emergency preparedness. The review covered the period of time from the last U. S. Nuclear Regulatory Commission (NRC) inspection of these areas to the present. The licensee's program was acceptably directed toward the protection of public health and safety, and in compliance with the NRC requirements. No violations or deviations were identified.

Organizational Structure and Functions

- The organizational structure and staffing were consistent with Technical Specification requirements.

- Staffing was as required by the Technical Specification and appeared to be adequate for safe operation of the reactor facility.

Review and Audit and Design Change Functions

- The Reactor Advisory Committee and associated subcommittees were meeting at the required frequency and were conducting reviews and audits of the topics outlined in the Technical Specification.

- The review and evaluation of changes to facility structures, systems, and components, as well as of changes to procedures and experiments, satisfied NRC requirements specified in Title 10 of the *Code of Federal Regulations* Section 50.59.

Reactor Operations

- Reactor operations were conducted in accordance with written procedure and were acceptable.

- Operations shift turnovers and operator cognizance of facility conditions were acceptable.

- Various daily and weekly meetings were being held to ensure proper planning and preparation.

- The Corrective Action Program implemented by the licensee was functioning as designed.

Operator Requalification

- Operator requalification was being completed as required by the Requalification Program and the program was being maintained up-to-date.

- Operators were receiving their biennial physical examinations as required.

Maintenance and Surveillance

- The Work Control Program established and implemented by the licensee was being used to effectively complete maintenance activities at the facility.

- The surveillance program currently in use by the licensee satisfied Technical Specification requirements.

Fuel Handling

- Fuel movements were conducted in accordance with Technical Specification and procedural requirements.

- Fuel inspections were being completed as required.

Experiments

- The program for reviewing and conducting experiments satisfied Technical Specification and current procedural requirements.

- Changes/amendments to existing experiments were reviewed and approved as required.

Procedures

- The procedure revision, control, and implementation program satisfied Technical Specification requirements.

Emergency Preparedness

- The emergency preparedness program was conducted in accordance with the Emergency Plan.

- Training for all facility personnel was being conducted annually as required.

- Emergency response equipment was available and was being maintained and inventoried as required.

- Emergency drills were being conducted annually as required by the Emergency Plan and critiques were held following the drills.

REPORT DETAILS

Summary of Plant Status

The University of Missouri-Columbia (the licensee) continued to operate the 10 Megawatt (10 Mw) Research and Test Reactor in support of isotope production, silicon irradiation, reactor operator training, and various types of research. During the inspection, the reactor was operated continuously following the weekly maintenance shutdown to support laboratory experiments and product irradiation.

1. Organization and Staffing

a. Inspection Scope (Inspection Procedure [IP] 69006)

To verify that the licensee was complying with the requirements specified in Section 6.1 of the Missouri University Research Reactor (MURR) Technical Specifications (TS), Revision (Rev.) 14, authorized by Amendment No. 34 to the renewed facility operating license, dated October 10, 2008, the inspector reviewed selected aspects of the following:

- MURR organization and staffing
- Management and staff responsibilities outlined in the TS
- MURR Control Room Logbooks for the period from April through October 2010
- MURR Console Watch Logbooks for the period from April through October 2010
- MURR Reactor Operations Annual Report for the period from January 1, 2008 through December 31, 2008, issued February 23, 2009
- MURR Reactor Operations Annual Report for the period from January 1, 2009 through December 31, 2009, issued February 24, 2010

b. Observations and Findings

The inspector noted that the organizational structure had not changed since the last inspection in the area of reactor operations (refer to NRC Inspection Report No. 50-186/2008-203). However, it was noted that, during the period since the last inspection, the Chief Operating Officer had retired. The Director of the facility was in the process of determining a reorganization to redistribute the organizational work load.

Through a review of selected reactor operations logs for the period from October 2009 through October 2010, and through interviews with operations personnel, the inspector determined that the licensee continued to operate with five crews on a four-shift rotation. This allowed time for the “extra” crew to have additional training and procedure review on a rotating basis. Each operating crew was staffed with three or four individuals, with at least three people per shift. Operations shifts continued to be scheduled for a period of 12 hours.

TS Section 6.1.i required that there be two facility staff personnel at the facility during reactor operation. The inspector verified that staffing during reactor operations satisfied this requirement.

c. Conclusion

The MURR organizational structure and staffing were consistent with the requirements of TS Section 6.1 and Figure 6.0. Staffing appeared to be adequate for safe operation of the facility.

2. Review and Audit and Design Change Functions

a. Inspection Scope (IP 69007)

The inspector reviewed the review and audit and design change functions and selected aspects of the following to ensure compliance with TS Section 6.1:

- Reactor Advisory Committee (RAC) Charter, last revised February 3, 2004
- RAC meeting minutes from July 2009 through the present
- Isotope Use Subcommittee meeting minutes from June 2009 through the present
- Reactor Safety Subcommittee meeting minutes from July 2009 through the present
- Reactor Procedure Review Subcommittee meeting minutes from July 2009 through the present
- Charter of the Reactor Procedure Review Subcommittee of the RAC, last revised March 22, 2007
- 50.59 Screen Forms for the following:
  - Number 09-01, "FB-SH-120, Annual Inspection and Preventive Maintenance – BMI-1 Shipping Cask," completed March 8, 2010
  - Number 09-08, "Modification Record 01-14, Addendum 2 – 120/208V Electrical Distribution System Upgrade," completed August 31, 2009
  - Number 09-17, "Paging System Changes in Support of the Shipping and Receiving Building," completed October 20, 2009
  - Number 10-01, "Resetting of Annunciator Alarms," completed February 12, 2010
  - Number 10-04, "Modification Record 09-4, Cooling Tower Temperature Cooling," completed March 19, 2010
  - Number 10-06, "RM-HP-102, 'Stack Monitor Preventive Maintenance – Lab Impex," completed April 1, 2010
- Modification Record 90-1, Addendum 2, "Evacuation System Changes in Support of the Shipping and Receiving Building," package completed October 26, 2009
- Modification Record 01-2, Addendum 4, "Intercommunication and Paging in Support of the Shipping and Receiving Building," package completed October 26, 2009
- Modification Record 01-9, Addendum 3, "Emergency Electrical System in the Shipping and Receiving Building," package completed December 21, 2009

- Modification Record 10-1, “Addition of Junction Box and Terminal Board for Control Rod Drive “D” Drive Cable,” package completed September 27, 2010
- MURR Administrative Procedure AP-RR-003, “10 CFR 50.59 Evaluations,” Rev. 5, issued April 26, 2010
- MURR Administrative Procedure AP-RO-115, “Modification Records,” Rev. 6, issued July 1, 2010
- MURR Administrative Procedure AP-RO-135, “Reactor Utilization Requests,” Rev. 0, issued September 27, 2007
- MURR Emergency Procedure EP-RO-003, “Emergency Preparedness Training,” Rev. 3, issued May 3, 2010
- “2008 Independent MURR Reactor Operations Audit,” conducted by staff from the University of Missouri-Rolla, dated January 28, 2009
- “Documentation of the Annual Audit of the University of Missouri – Columbia Research Reactor by the Missouri University of Science and Technology (formerly University of Missouri – Rolla) Reactor for Calendar Year 2009,” dated Jan 28, 2010
- “Documentation of the Annual Review of the Reactor Operations Procedures for Calendar Year (CY) 2009 as required by Administrative TS Section 6.1.b,” conducted by reactor operators and managers, dated February 15, 2010
- “Documentation of Annual Review of the Emergency Plan and Implementing Procedures for CY 2009 as required by administrative TS Section 6.1.b,” conducted by reactor operators and managers, dated February 10, 2010
- “Documentation of the Annual Review of the Emergency Plan Implementing Procedures by the Facility Emergency Organization for CY 2009 as required by EP-RO-003, Section 1.1.2,” conducted by the Operations Training Coordinator and a licensed Senior Reactor Operator, dated February 17, 2010
- “Documentation of the Annual Review of the Operator Requalification Program for CY 2008 as required by Section 3.1 of the Program,” conducted by the Operations Training Coordinator and a licensed Senior Reactor Operator, dated February 10, 2010
- “Documentation of the Annual Review of the Reactor Utilization Request System for CY 2009,” conducted by the Reactor Manager, dated March 22, 2010
- “Operator Requalification Program – University of Missouri Research Reactor (MURR),” dated January 7, 1997
- MURR Reactor Operations Annual Report for the period from January 1, 2008 through December 31, 2008, issued February 23, 2009
- MURR Reactor Operations Annual Report for the period from January 1, 2009 through December 31, 2009, issued February 24, 2010

b. Observations and Findings

(1) Review and Audit Functions

Records of the meetings held from July 2009 to the present by the Reactor Advisory Committee (RAC). It was noted that the RAC had appointed various subcommittees, as allowed by the TS, to assist in performing the committee's various functions. These subcommittees included the Isotope Use Subcommittee, the Reactor Safety Subcommittee, and the Reactor Procedure Subcommittee. Through records review, the inspector determined that committee meetings were held each calendar quarter as required and reviews were conducted by the RAC or a designated subcommittee. Topics of these reviews were as specified by the TS. It was noted that the RAC provided appropriate guidance, direction, and oversight to ensure acceptable use and operation of the reactor.

The inspector reviewed selected audits that were conducted by various managers and other assigned staff and non-staff personnel. The audits covered various aspects of the reactor facility operations and programs for calendar year 2009 and 2010. The audits appeared to be thorough and complete. No significant problems or deficiencies were found during the audits but some areas for improvement were noted. Corrective actions were taken as needed.

(2) Design Change Functions

The regulatory requirements stipulated in 10 CFR 50.59 were implemented at the facility through MURR Procedures AP-RR-003 and AR-RO-115. The procedures were developed to address changes to the facility Hazards Summary Report (HSR), modifications to the facility, changes to MURR procedures, new tests or experiments not described in the HSR, revisions to NRC approved analysis methodology, and/or proposed compensatory actions to address degraded or non-conforming conditions. The procedures adequately incorporated criteria provided by the regulations with additional requirements mandated by local conditions.

The inspector verified that all new and revised procedures generated at the facility were screened with respect to the above procedures. Also, non-routine maintenance activities and all facility modifications were identified for screening by the facility Work Control Group with input from the on-duty operations personnel, including the Lead Senior Reactor Operator (LSRO). The procedure changes were processed through, and controlled by, the Document Control Coordinator while the maintenance activities and modification packages were processed through, and controlled by, the Assistant Reactor Manager - Operations. The inspector verified that changes to procedures were reviewed by the Procedure Review Subcommittee and that the proposed non-routine maintenance activities and facility modifications were reviewed by the Reactor Manager.

The changes and modifications were typically reviewed by the Reactor Safety Subcommittee as well. The changes and modifications were subsequently reviewed and approved by the RAC as required.

The inspector reviewed selected Modification Records and 50.59 Screen Forms processed during 2009 and 2010. Each completed modification (mod) package typically consisted of a description of the mod; a Hazards Summary Report Evaluation; a Reactor Safety Evaluation; Operating, Preventative Maintenance, and Compliance Procedure and Print Evaluation; Spare Parts Requirements Evaluation; and a 50.59 Screen Form. Each package also contained proposed procedure revisions, a list of new spare parts that could be needed, and changes to affected facility prints/drawings as needed. The completed packages showed that the issues were acceptably reviewed in accordance with the procedures. It was noted that none of the changes or modifications were determined to constitute a safety question or concern and none required a license or TS amendment.

c. Conclusion

The RAC and associated subcommittees were meeting as required and reviewing the topics outlined in the TS. The design change program was comprehensive and satisfied NRC requirements.

3. Reactor Operations

a. Inspection Scope (IP 69006)

To verify that the licensee was operating the reactor, communicating plant information, and implementing the Corrective Action Program in accordance with TS Section 3 and procedural requirements, the inspector reviewed selected portions of the following:

- Unscheduled Power Reduction Reports for 2009 and 2010
- Operations Shift Turnover sheets for June through October 2010
- MURR Control Room Logbooks for the period from April through October 2010
- MURR Console Watch Logbooks for the period from April through October 2010
- MURR Procedure AP-RO-110, “Conduct of Operations,” Rev. 15, issued October 27, 2009, and the associated forms, FM-57, “Long Form Startup Checklist,” and FM-58, “Short Form Startup Checklist”
- MURR Administrative Procedure AP-RR-001, “Corrective Action Program,” Rev. 11, issued April 26, 2010
- MURR Procedure OP-RO-210, “Reactor Startup - Normal,” Rev. 10, issued July 15, 2010
- MURR Procedure OP-RO-220, “Reactor Shutdown or Power Reduction,” Rev. 5, issued July 2, 2008

- MURR Procedure OP-RO-230, “Changing Reactor Power Level,” Rev. 5, issued October 1, 2008
- MURR Reactor Operations Annual Report for the period from January 1, 2008 through December 31, 2008, issued February 23, 2009
- MURR Reactor Operations Annual Report for the period from January 1, 2009 through December 31, 2009, issued February 24, 2010

b. Observations and Findings

(1) Reactor Operation

The inspector observed facility activities on various occasions during the week including a reactor start-up, routine reactor operations, and the handling of samples and sample manipulating tools. Written procedures and checklists were used for each activity as required. It was noted that the reactor operators followed the procedures and were knowledgeable and professional in the conduct of their duties. Health Physics personnel provided coverage as needed/required.

(2) Staff Communication

During the inspection, the inspector attended operations crew shift turnover meetings on Monday evening and Wednesday morning. These turnover briefings were held at 6:30 a.m. and 6:30 p.m. each day. The status of the reactor and the facility was discussed on each occasion as required. All operators of the relief crews reviewed the appropriate logs and records and were briefed on the upcoming shift activities and scheduled events before assuming the operations duty. Through direct observation and records review, the inspector verified that the content of shift turnover briefings held during each shift change was appropriate and noted that shift activities and plant conditions were discussed in detail.

The inspector attended the “Plan of the Day” (POD) meeting on Tuesday, Wednesday, and Thursday morning. The meeting, chaired by the Reactor Manager, was held daily and representatives from all organizations at the facility were in attendance. Safety-significant issues, if any, were discussed and maintenance or operating needs were presented. Any concerns or schedule conflicts were resolved during the meeting. The inspector noted that the POD meeting provided the opportunity for everyone to be made aware of current facility conditions and the scheduled activities for that day.

The inspector attended the “Maintenance Meeting” held on Tuesday afternoon. The meeting was chaired by the Reactor Manager and was typically attended by the LSRO of the operations crew in training that week, the Assistant Reactor Manager - Physics, the Assistant Reactor Manager - Engineering, the Assistant Reactor Manager - Operations, the Work Control Manager, and persons from the various facility support groups. The schedule for the maintenance activities to be conducted

during the next scheduled shutdown was presented and discussed in detail. (A scheduled shutdown is conducted every Sunday night through Monday morning.) Needed materials and support group assistance were reviewed and coordinated. All routine, periodic maintenance items were tracked through the Work Control Program. Surveillance items were tracked by the Assistant Reactor Manager – Operations.

(3) Corrective Action Program

The inspector reviewed the licensee's Corrective Action Program (CAP) which had been developed to provide staff members with a formal process to identify deficiencies and bring safety issues, as well as other issues of concern, to management's attention for resolution. The program was designed so that anyone could identify a discrepancy, concern, or improvement opportunity and enter the issue into the CAP system via the MURR intranet. When issues were identified, each one was screened for safety significance, evaluated to determine the cause and its contributing factors, and assigned to a responsible manager for resolution. Corrective actions were developed and implemented consistent with the significance of the issue and according to an established schedule. The status of each CAP issue was tracked and staff members could check on the issue of their concern whenever they wanted.

This year, to date, 34 issues had been entered into the CAP system. It was noted that the events were now classified into one of four categories: Personnel Safety/Reactor, Personnel Safety/Radiological or Regulatory, Improvement Opportunity, or Trend. The inspector reviewed those events and found that the licensee had taken corrective actions as necessary or had assigned a responsible manager to take the needed actions.

c. Conclusion

MURR reactor operations, as well as shift turnovers and operator cognizance of facility conditions during startup and routine operation, were acceptable. Various daily and weekly meetings were being held to ensure proper planning and preparation for operations activities. The CAP was functioning as required by procedure.

4. Operator Requalification

a. Inspection Scope (IP 69003)

The inspector reviewed selected aspects of the following to ensure compliance with the "Operator Requalification Program - University of Missouri Research Reactor (MURR)" dated January 7, 1997, and clarified by a Memorandum dated March 30, 2001:

- Current status of operator licenses
- "Change Review Sheets" for 2009 and 2010

- Medical examination records for the past three years
- MURR Operator Requalification Program training and examination records for 2009 and 2010 including:
  - "Annual Operating Test Records"
  - "MURR Operator Active Status Log"
  - "Annual On-The-Job Training Requirement/Checklists"
  - MURR Operational Task forms documenting 5 different evaluated tasks completed by each operator every year
- "Annual Requalification Tasks related to the Facility and Reactor" Notebook
- "Annual Requalification Tasks for Abnormal and Emergency Conditions" Notebook
- "Written Examination Forms" for 2009 documenting the facility-administered biennial exam completed by each operator

b. Observations and Findings

There were twelve qualified Senior Reactor Operators (SROs) and eleven Reactor Operators (ROs) on staff at the facility. The licensee indicated that there were two people in training to become operators. The inspector noted that, of the 23 qualified operators at the facility, four were managers (three SROs and one RO) and one was the Operations Training Coordinator (also an SRO). The inspector verified that the Requalification Program was maintained up-to-date and RO and SRO licenses were current. MURR Operator Active Status Logs and records also showed that operators maintained active duty status as required or were required to complete six hours of reactor operations under supervision prior to being reinstated to active duty status.

A review of the logs and records showed that training was being conducted in accordance with the licensee's requalification and training program. Procedure reviews and examinations had been documented as required. Information regarding facility changes and other relevant information had been routed under the Crew Review process and licensed operators acknowledged their review of this information. The inspector verified that quarterly reactor operations, reactivity manipulations, other required operations activities, and Reactor Supervisor activities were being completed as required and the appropriate records were being maintained. Records indicating the completion of the annual operations tests and supervisory observations were also maintained. Biennial written examinations were being completed by the operators as required. The inspector also noted that all operators were receiving biennial medical examinations within the allowed time frame as required by the program.

The inspector reviewed the last biennial requalification examination which had been administered in October of 2009. It was noted that the exam was similar in its level of difficulty as compared to NRC-administered examinations. The licensee indicated that the next biennial examination was scheduled for the October/November time frame in 2011.

c. Conclusion

Operator requalification was being conducted in accordance with the Operator Requalification Program requirements. Operators were receiving their biennial physical examinations as required.

5. Maintenance and Surveillance

a. Inspection Scope (IP 69006, 69010)

To verify that the licensee was meeting the requirements of their Preventive Maintenance Program and complying with TS requirements concerning the surveillance program, the inspector reviewed selected aspects of:

- "Maintenance Lists" for 2009 and 2010
- Selected MURR Compliance Procedures
- Entries in the "Completed PM's Notebook"
- Various "Preventive Maintenance Requirement Cards"
- Selected Compliance Procedure data sheets and records
- Various "Weekly Worklists for Maintenance Shutdown for 2010" kept in the "Maintenance Day Book"
- MURR Procedure AP-RR-015, "Work Control Procedure," Rev. 13, issued October 22, 2008
- MURR Procedure GS-RA-100, "MURR Equipment Tag Out," Rev. 9, issued July 28, 2010
- MURR Operator Aid OA-21, "MURR Maintenance Guidelines," Rev. 4, issued July 31, 2007
- MURR Reactor Operations Annual Report for the period from January 1, 2008 through December 31, 2008, issued February 23, 2009
- MURR Reactor Operations Annual Report for the period from January 1, 2009 through December 31, 2009, issued February 24, 2010

b. Observations and Findings

(1) Maintenance

The inspector reviewed the Work Control Program that the licensee had developed to handle maintenance activities. The program was designed to ensure that all maintenance activities were screened, planned, and completed as scheduled, that post maintenance testing was conducted, and that the entire process was documented appropriately. The inspector noted that periodic surveillance activities were not scheduled through the Work Control Program. The licensee explained that this was because the program was not yet flexible enough to accommodate the scheduling of these activities. Surveillance items were scheduled as needed by the Assistant Reactor Manager – Operations. Because of the recurring nature of the surveillance items, an annual schedule was developed and maintained throughout the year with changes only required if equipment or

components failed to operate properly. As noted previously, all these activities were discussed and coordinated through the "Maintenance Meeting" held each week. The program appeared to be very effective.

(2) Surveillance

Various periodic surveillance verifications and calibration of equipment, including the testing of various reactor systems, instrumentation, auxiliary systems, and security systems and alarms, were reviewed by the inspector. The licensee used "Compliance Procedures" (CPs) to conduct these verifications and followed the same established schedule each year. The data recorded in the Logbooks and on the CP records indicated that the verifications and calibrations had been completed on schedule and in accordance with licensee procedures. The results reviewed by the inspector were noted to be within the TS and procedurally prescribed parameters.

c. Conclusion

The Work Control Program established and implemented by the licensee was being used effectively to complete maintenance activities at the facility. The surveillance program currently in use by the licensee satisfied TS requirements.

6. Fuel Handling

a. Inspection Scope (IP 69009)

To ensure that the licensee was handling and moving fuel appropriately and completing fuel inspections as required by TS Sections 3.8, 4.1, 4.3, and 5.5, the inspector reviewed selected aspects of the following:

- Fuel Status Board located in the Control Room
- Selected Fuel Element Inspection Sheets for 2009 and 2010
- MURR Fuel Status Maps sheets developed by the Assistant Reactor Manager - Physics
- Visual Inspection of End Plate Surfaces forms completed for fuel elements inspected in 2010 to identify end-of-life anomalies
- Selected Fuel Movement Sheets developed prior to fuel movements that were typically completed on the weekly scheduled Maintenance Day and for fuel inspections
- MURR Form FM-152, "Fuel Element Inspection," Rev. 1, issued July 9, 2007
- MURR Procedure OP-RO-250, "In-Pool Fuel Handling," Rev. 13, issued September 27, 2010
- MURR Procedure RP-RO-100, "Fuel Movement," Rev. 9, issued June 5, 2009

b. Observations and Findings

The inspector reviewed the fuel movement process and verified that fuel was moved according to established procedure and in accordance with the specific fuel movement sheets developed by the Assistant Reactor Manager-Physics for each core loading. The inspector reviewed selected fuel movement sheets for 2010. They had been developed and used for core refueling, partial core refueling, loading of spent fuel into a shipping container, performing end-of-life inspections of fuel elements, and transferring new unirradiated fuel from storage to the pool. The inspector noted that proper radiation control and security precautions were required by the applicable procedure. The inspector also compared the location of fuel elements in the reactor core with the information maintained on the Fuel Status Board in the Control Room, on the current MURR Fuel Status Map, and on the fuel movement sheet for the latest core, Core Number 10-47. No problems or anomalies were noted.

The inspector also reviewed selected fuel inspection sheets that had been completed during 2010. TS Section 5.5 requires that one out of every eight spent fuel elements be inspected for anomalies. The inspection sheets showed that the licensee noted uniform discoloration on the outer and inner plate surfaces but no anomalies on the spent fuel elements inspected. Also, there was no swelling in the water gap between the fuel plates in the elements. The inspections were completed in compliance with TS Section 5.5.

c. Conclusion

Fuel movements and inspections were conducted in accordance with TS and procedural requirements.

7. Experiments

a. Inspection Scope (IP 69005)

The inspector reviewed the licensee's program for conducting experiments and selected aspects of the following to verify compliance with TS Sections 3.6 and 6.1.f:

- Listing of current experiments
- Current list of Reactor Utilization Requests (RURs)
- MURR Reactor Utilization Request Number (No.) 243-6, "Flooded Can Experiments," approval dated July 29, 2004, with the latest Amendment approval dated August 11, 2009
- MURR Reactor Utilization Request No. 433, "Lanthanum Nitrate – $La(NO_3)_3$," approval dated January 27, 2009
- MURR Reactor Utilization Request No. 435, "Molybdenum Trioxide (Molybdenum Oxide)," approval dated January 31, 2010
- MURR Reactor Utilization Request No. 436, "Hydroxyapatite – $Ca_{10}(PO_4)_6OH_2$," approval dated March 23, 2010

- MURR Procedure AP-RO-135, “Reactor Utilization Requests,” Rev. 0, issued September 27, 2007
- MURR Procedure EX-RO-105, “Reactor Irradiation Experiments,” Rev. 13, issued December 29, 2009
- MURR Procedure EX-RO-124, “Beamport ‘E’ Operation,” Rev. 9, issued September 27, 2010
- MURR Procedure EX-RO-126, “Thermal Column Door,” Rev. 5, issued December 29, 2009
- “Documentation of the Annual Review of the Reactor Utilization Request System for CY 2009,” conducted by the Reactor Manager, dated March 22, 2010
- MURR Reactor Operations Annual Report for the period from January 1, 2008 through December 31, 2008, issued February 23, 2009
- MURR Reactor Operations Annual Report for the period from January 1, 2009 through December 31, 2009, issued February 24, 2010

b. Observations and Findings

The experiments conducted at the facility were required to be evaluated and reviewed using MURR Administrative Procedure AP-RO-135, “Reactor Utilization Requests.” The procedure required an individual proposing a new experiment to evaluate the irradiation of the target material to determine that, if performed within the limitations stated in the RUR safety evaluation, the irradiation experiment would remain within the TS limits for experiments. The safety evaluation included a review of: 1) thermal effects, 2) possible sample decomposition and pressure effects, 3) experiment failure, 4) loss of coolant flow, 5) failure of other experiments, 6) corrosive effects of the sample, and 7) possible explosive potential. The evaluation was also required to address post irradiation sample handling procedures, detection of radioactivity produced, radiation hazards, and reactivity worth. Each RUR, or new amendment, was required to be reviewed by the Assistant Reactor Manager – Physics and the Health Physics Manager. If the experiment under review did not involve a new class of experiment or a question pursuant to 10 CFR 50.59, the Reactor Manager would then approve the RUR. Any RURs involving a new class of experiment or a safety question were required to be reviewed by the Reactor Safety Subcommittee. These RURs were then reviewed and, if properly analyzed and acceptable, were approved by the RAC.

The inspector noted that the RURs most commonly used at the facility were for product or sample irradiation. These included: 1) MURR RUR No. 219, “Irradiation of Materials in the Reactor Pool,” originally approved September 12, 1974 with numerous revisions and amendments, and 2) MURR RUR No. 254, “Pneumatic Tube Irradiations,” Rev. 1, dated April 7, 2004.

The inspector reviewed various recently proposed RURs or amendments to previously approved RURs that had been submitted for review and approval. The experiments had been evaluated in accordance with TS requirements and the accompanying data sheets indicated that they were within reactivity limits. The analysis for each had been performed and the reviews and approvals completed.

The inspector noted that the experiments in progress during the inspection were conducted with the cognizance of the reactor manager and the LSRO, and in accordance with TS requirements (e.g., reactivity limitations). The experiments reviewed by the inspector were being conducted in accordance with procedure and the materials produced were handled and transferred as required.

c. Conclusion

The program for reviewing and conducting experiments satisfied TS and procedural requirements.

8. Procedures

a. Inspection Scope (IP 69008)

To verify compliance with TS Sections 6.1.b and 6.1.c, the inspector reviewed selected portions of the following:

- MURR Policy POL-18, "Procedure Writer's Guide," Rev. 7, issued October 5, 2009
- MURR Procedure AP-HP-130, "Reactor License Projects Annual Review," Rev. 4, issued September 30, 2010
- MURR Procedure AP-RR-002, "Deviation From Procedure," Rev. 1, issued August 24, 2010
- MURR Procedure EP-RO-003, "Emergency Preparedness Training," Rev. 3, issued May 3, 2010
- MURR Procedure OP-RO-211, "Reactor Start-up-Hot," Rev. 8, issued August 20, 2010
- MURR Procedure OP-RO-250, "In-Pool Fuel Handling," Rev. 13, issued September 27, 2010
- MURR Procedure OP-RO-461, "Pool Coolant System – One Pump Operation," Rev. 10, issued August 20, 2010
- "Documentation of the Annual Review of the Reactor Operations Procedures for Calendar Year (CY) 2009 as required by Administrative TS Section 6.1.b," conducted by reactor operators and managers, dated February 15, 2010
- "Documentation of Annual Review of the Emergency Plan and Implementing Procedures for CY 2009 as required by administrative TS Section 6.1.b," conducted by reactor operators and managers, dated February 10, 2010
- MURR Reactor Operations Annual Report for the period from January 1, 2008 through December 31, 2008, issued February 23, 2009
- MURR Reactor Operations Annual Report for the period from January 1, 2009 through December 31, 2009, issued February 24, 2010

b. Observations and Findings

MURR TS 6.1.b required that the Reactor Manager annually review and approve the Reactor Operations and Emergency Preparedness Procedures. The inspector verified that the various operations procedures, as well as the Emergency Plan Implementing procedures, were being reviewed annually as required and revised as needed.

MURR TS 6.1.c required that the RAC review procedure changes with safety significance. The Reactor Procedure Review Subcommittee was chartered to fulfill this requirement. The inspector verified that the subcommittee was meeting as required to review current procedure revisions and changes.

The inspector noted that nearly all of the current MURR procedures had been through a review and revision process. All the procedures that have been revised and/or reformatted in accordance with the MURR Procedure Writer's Guide were being tracked within an established database. Each month the Document Control Coordinator queried the database to flag all the procedures that were due for annual review. This allowed the authors/owners of the procedures, and the managers responsible for reviewing them, the opportunity of reviewing small sets of procedures throughout the year instead of requiring all the procedures to be reviewed at one time.

The inspector observed various activities during the inspection. All operations observed were conducted in accordance with procedures and no problems were noted. Procedure compliance was acceptable.

c. Conclusion

The procedure review, revision, control, and implementation program satisfied TS requirements.

9. Emergency Preparedness

a. Inspection Scope (IP 69011)

The inspector reviewed selected aspects of the following to verify compliance with the "Emergency Plan for the University of Missouri Research Reactor Facility," latest revision issued April 13, 2007:

- Assistance to be provided by offsite support groups
- Operations Shift Turnover sheets for June through October 2010
- MURR Emergency Call List, FM-104, Rev. 14, dated June 11, 2010
- Letter of Agreement with the City of Columbia dated October 21, 2005
- MURR Operator Requalification Program training and examination records documenting emergency preparedness training of operators
- MURR Control Room Logbooks for the period from April through October 2010

- MURR Console Watch Logbooks for the period from April through October 2010
- Documentation of the 2009 and 2010 emergency drills including the associated critiques
- MURR Emergency Procedures Manual, Rev. 57, updated June 11, 2010, containing MURR Emergency Procedures, EP-RO-001 through EP-RO-020
- MURR Reactor Emergency Procedures, REP-RO-100, "Reactor Emergency Procedures," Rev. 11, issued January 15, 2010
- "Documentation of Annual Review of the Emergency Plan and Implementing Procedures for CY 2009 as required by administrative TS Section 6.1.b," conducted by reactor operators and managers, dated February 10, 2010
- "Documentation of the Annual Review of the Emergency Plan Implementing Procedures by the Facility Emergency Organization for CY 2009 as required by EP-RO-003, Section 1.1.2," conducted by the Operations Training Coordinator and a licensed Senior Reactor Operator, dated February 17, 2010
- ANSI/ANS-15.16, "Emergency Planning for Research Reactors," Draft II, dated November 1981

b. Observations and Findings

The inspector reviewed the Emergency Plan (E-Plan) in use at the reactor and verified that the E-Plan was reviewed annually as required. The Emergency Procedures Manual (containing E-Plan implementing procedures) was also reviewed annually and revised as needed to ensure effective implementation of the E-Plan.

Through records review and interviews with Facility Emergency Organization (FEO) personnel (i.e., MURR emergency responders), the inspector determined that they were knowledgeable of the proper actions to take in case of an emergency. Training for FEO staff members had been conducted annually as required and documented acceptably. Emergency training for operators was completed and tracked through the Operator Requalification Program.

The inspector verified that the Letter of Agreement with the City of Columbia was being maintained. The agreement verified that the City of Columbia Fire Department would provide support for the facility and would be available during an emergency. Communications capabilities with support groups were acceptable and had been periodically tested. Emergency Call Lists had been revised and updated as needed and were available in the Control Room, the front lobby, and in the various controlled copies of MURR Emergency Procedures Manuals as required. The inspector also verified that emergency equipment was available and was being inventoried quarterly as required.

The documentation of the drills conducted during 2009 and 2010 was reviewed. Emergency preparedness and response training for Emergency Support Organizations was being completed prior to the drills (during the meetings held to

prepare for the drills.) Through drill scenario and record reviews, off-site emergency responders were determined to be knowledgeable of the proper actions to take in case of an emergency. Emergency drills had been conducted annually as required by the E-Plan. Critiques were held following the drills to document the strengths and weaknesses identified during the exercise. Action items were developed to correct the problems noted.

On Wednesday, November 3, 2010, the inspector, accompanied by licensee personnel, visited the University of Missouri Hospital and toured the emergency response facilities that would be available in case of an emergency. Since the hospital also serves the emergency needs of the nearby Callaway Nuclear Power Plant, it was noted to be well equipped and staffed to handle any problem that might arise at the MURR facility. There appeared to be a good working relationship between the licensee and this support group.

c. Conclusion

The emergency preparedness program was conducted in accordance with the Emergency Plan. Training was being conducted annually as required. Emergency response equipment was available and being maintained and inventoried as required. Emergency drills were being conducted annually as required by the Emergency Plan with support organizations participating biennially.

10. Exit Interview

The inspection scope and results were reviewed with the licensee on November 4, 2010. The inspector discussed the findings for each area reviewed. The licensee acknowledged the findings and did not identify as proprietary any of the material provided to or reviewed by the inspector during the inspection.

PARTIAL LIST OF PERSONS CONTACTED

Licensee Personnel

R. Dobey	Health Physics Manager
J. Ernst	Associate Director, Regulatory Assurance Group
L. Foyto	Reactor Manager
J. Fruits	Assistant Reactor Manager - Operations
C. Herbold	Assistant Reactor Manager - Engineering
R. Hudson	Operations Training Coordinator and Senior Reactor Operator
M. Kraus	Safety Associate and CAP Coordinator
D. Kutikad	Assistant Reactor Manager - Physics
S. McCall	Lead Senior Reactor Operator

Other Personnel

C. Smith	Coordinator, Worker Safety and Emergency Preparedness, University of Missouri Health Care, University Hospital

INSPECTION PROCEDURES USED

IP 69003	Class I Research and Test Reactor Operator Licenses, Requalification, and Medical Activities
IP 69005	Class I Research and Test Reactor Experiments
IP 69006	Class I Research and Test Reactor Organization, Operations, and Maintenance Activities
IP 69007	Class I Research and Test Reactor Review and Audit and Design Change Functions
IP 69008	Class I Research and Test Reactor Procedures
IP 69009	Class I Research and Test Reactor Fuel Movement
IP 69010	Class I Research and Test Reactor Surveillance
IP 69011	Class I Research and Test Reactor Emergency Preparedness

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

None

Closed

None

LIST OF ACRONYMS USED

10 CFR	Title 10 of the *Code of Federal Regulations*
CAP	Corrective Action Program
CP	Compliance Procedure

E-Plan	Emergency Plan
FEO	Facility Emergency Organization
IP	Inspection Procedure
IR	Inspection Report
LSRO	Lead Senior Reactor Operator
MU	University of Missouri
MURR	University of Missouri-Columbia Research Reactor
NRC	U. S. Nuclear Regulatory Commission
POD	Plan of the Day (meeting)
RAC	Reactor Advisory Committee
Rev.	Revision
RO	Reactor Operator
RUR	Reactor Utilization Request
SRO	Senior Reactor Operator
TS	Technical Specification